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# Proposal for the seismic mitigation retrofit and life-cycle replacements project at the Economic and Social Commission for Asia and the Pacific premises in Bangkok

## Report of the Secretary-General

*Summary*

The present report is submitted pursuant to General Assembly resolution 70/248, section XII, in which the Assembly endorsed the recommendations contained in the report of the Advisory Committee on Administrative and Budgetary Questions (A/70/7/Add.3) and requested the Secretary-General to submit a revised proposal for the seismic mitigation retrofit and life-cycle replacement project to the Assembly for its consideration at the main part of its seventy-first session.

The present report provides a summary of the progress made since the previous report, an overview of the project objectives and a description of the proposed project governance structure. In line with guidance received from the General Assembly, the report includes an analysis of four options for the project, including the possibility of separating or combining the seismic and life cycle scopes, and implementation options for each, including single and multiphased.

Of the four options studied, the Secretary-General recommends option C, which is a combination of the seismic and life cycle scopes undertaken in multiple phases over an expeditious timeline of six years, comprising a two-year design phase and four-year construction phase. The total project cost is estimated at $40,019,000 at initial rates, inclusive of escalation and contingency. In addition to being the most cost-effective option, option C would provide also the added benefit of carrying the lowest risk and providing additional long-term efficiencies in energy and space.

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**It is recommended that the General Assembly take note of the report, approve the proposed scope, cost and implementation strategy of option C, approve the establishment of the dedicated project management team and project support staff, appropriate the resources of $877,400 in 2017 for design and project management services and approve the establishment of a multi-year construction-in-progress account for this project.**

# I. Introduction

## A. Background

1. The headquarters of the Economic Commission for Asia and the Far East (ECAFE) was established in Shanghai in 1947 and was moved temporarily to Bangkok in 1949. In 1970, Bangkok was formally designated as the headquarters seat of ECAFE, and in 1974 the name ECAFE was changed to the present name, Economic and Social Commission for Asia and the Pacific (ESCAP).

2. In 1970, the Government of Thailand made available a site on which the United Nations could build new facilities required for ESCAP. The foundation stone-laying ceremony for the facilities, which comprised a secretariat building and a service building, was conducted by the Prime Minister of Thailand on United Nations Day, 24 October 1972. The facilities were ceremonially inaugurated by King Bhumibol Adulyadej on United Nations Day, 24 October 1975. ESCAP premises in Bangkok presently comprise three reinforced concrete buildings, as detailed below and shown in annex I to the present report:

(a) Secretariat building: a 15-floor high-rise building with 17,379 square metres ($m^2$) of office space and 1,288 workstations. The secretariat building was built in the early 1970s;

(b) Service building: a four-floor building with two basement floors, with a total of 5,826 $m^2$ of office space and 456 workstations; the service building was also built in the early 1970s;

(c) United Nations Conference Centre: a three-floor structure with two basement floors, with a total of 2,681 $m^2$ of office space and 129 workstations. The Centre was built more recently, in the early 1990s.

3. Serving as the regional arm of the Economic and Social Council, ESCAP, along with its premises, provides its Member States and the host country with a platform for inter-governmental cooperation and knowledge-sharing on topics such as understanding projected risks and exposure specific to the region, as well as expertise and best practices in various domains of the development agenda.

4. ESCAP in Bangkok annually hosts approximately 3,000 meetings, which are attended by more than 55,000 participants who deliberate on issues critical to the region, thus providing Member States with the opportunity to be better prepared to deal with regional issues.

5. When the secretariat and service buildings were designed and constructed in the early 1970s there were no national seismic codes in place. These were introduced in Thailand only in 1997, and the secretariat and service buildings do not conform to current Thai seismic codes. Studies carried out by ESCAP since 2011 to assess the structural integrity and the life safety of the building envelope, including marble cladding and glazing, have identified specific vulnerabilities. Further assessments performed by professional seismic engineering consultants from 2012 to 2014 indicate that those vulnerabilities require seismic mitigation measures to safeguard staff and visitors in the event of earthquakes.

6. The overarching objective of the project is to comply with seismic and other fire and life-safety codes for the premises so that staff, delegates and visitors to ESCAP are not exposed to any unnecessary life safety risk.

7. The proposed project also provides opportunities for the most cost-effective method to address other long-term benefits for the Organization related to building performance, energy conservation, space usage and the life-cycle replacement of building systems that have reached the end of their useful lives.

## B. Seismic risk at the Commission in Bangkok

8. The internationally recognized standards for measuring earthquakes are the Richter[1] and the Mercalli Intensity scales. In the seismic design industry, the seismic threat is generally understood to refer to "peak ground acceleration", which is defined as the largest ground motion recorded during an earthquake. The risk is caused by two factors, that is, the seismic sources and the soil conditions. The soil characteristics at ESCAP premises are such that the soil is potentially prone to liquefaction during large earthquakes, which can significantly reduce the structural stability of the buildings. The combination of these two factors determines the seismic risk. The seismic source generates the peak ground acceleration at a location and the soil conditions play a significant role in determining the intensity of the seismic force (for example, on buildings) at that location. The combination of the two factors can cause severe damage and life-safety risk.

9. The peak ground acceleration for ESCAP would be classified as moderate potential to cause damage to resistant structures, and moderate/heavy potential to cause damage to vulnerable structures. Bangkok is surrounded by seismically active zones; studies from research centres and universities in Thailand[2] have found active faults in Nakhon Nayok province, which is located 100 kilometres (km) north-east of Bangkok. Recorded data show that local peaks up to 0.9 g, coupled with the particular soil and bedrock characteristics of the Bangkok area, could magnify the seismic forces in the city and make the threat significant.

10. In 1985, Mexico City suffered large-scale damage during the Michoacán earthquake. The earthquake was caused by a series of seismic events beginning at the Middle America Trench, more than 350 km from Mexico City. At least 5,000 people were killed, and 412 buildings collapsed and another 3,124 were seriously damaged in Mexico City, resulting in between $3 billion and $4 billion in damage.[3] Similar conditions exist for the Bangkok area in terms of seismic sources and soil conditions, which are clayey due to being the flood plains of the Chao Phraya river, and have the potential to amplify earthquake ground motions by a factor of approximately three to four.[4]

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[1] http://earthquake.usgs.gov/learn/topics/measure.php.

[2] Songpop Polchan, President of the Geological Society of Thailand, seminar of geological professionals (5 July 2012), see http://www.nationmultimedia.com/national/Thailands-15th-faultline-discovered-in-Nakhon-Nayo-30185583.html [accessed on 2 July 2016].

[3] Paul Lawrence Haber, "Earthquake of 1985", in *Concise Encyclopedia of Mexico*, Michael S. Werner, ed. (Chicago, Illinois, Fitzroy Dearborn Publishers, 2001).

[4] Pennung Warnitchai et al, "Seismic hazard in Bangkok due to long-distance earthquakes", twelfth World Conference on Earthquake Engineering (2000).

11. The potential maximum ground motion could cause severe damage to or even complete collapse of structures, such as the secretariat building. Accordingly, it is imperative that such risks are mitigated to the fullest extent possible.

# II. Progress made since the previous report of the Secretary-General (A/70/356) and review of the existing conditions of the Commission's buildings

12. The General Assembly, in its resolution 70/248, section XII, paragraph 5, requested the Secretary-General to present an updated proposal and costing estimates for multiphase and single-phase implementation methods, including an option to address the seismic risk on its own and an option in combination with renovation, life-cycle replacement or other works, ensuring the most cost-effective and efficient method of implementation. Activities undertaken to date include (a) seeking support from the host Government and Member States; (b) assessment of the existing conditions of ESCAP buildings; (c) incorporation of local knowledge and lessons learned from other Secretariat capital projects and international best practices; and (d) development of the swing space requirements for project implementation. Progress and findings are summarized in this section of this report.

## A. Support from the host Government and Member States

### Host Government

13. ESCAP has continued to engage with the Ministry of Foreign Affairs of the host country to seek its assistance and support for the project. Several meetings were held during the reporting period between the Division of Administration of the Commission and the host country's Administrative Affairs Division of the Ministry of Foreign Affairs. In particular, ESCAP has requested support with regard to provisional office space to be used as swing space to temporarily accommodate United Nations staff during project implementation. On 3 May 2016, the ESCAP Executive Secretary sent a note verbale requesting the host country to indicate any plans to provide assistance and support to the project through either in-kind contributions or interest-free loans.

14. On 17 March 2016, the host country advised ESCAP of three possible locations, and, upon further study, one location is deemed a viable option to meet the swing space requirements. That location is Building "BC" of the Government Complex at Chaeng Wattana, located approximately 30 km north of ESCAP. It is currently under renovation (a floor on the roof of a parking structure is being constructed) and will provide up to 3,200 $m^2$ of office space. This is a promising option suitable for the Commission's swing space. Detailed discussions with the host country are ongoing as of the issuance of the present report.

### Member States

15. ESCAP solicited assistance and support for the project from Member States during the meeting of the Advisory Committee of Permanent Representatives of the Commission held in Bangkok on 24 March 2016. Support was requested in the form of voluntary contributions, either in-kind by way of technical experts or sharing

lessons learned, or other contributions such as loans. On 2 May 2016 the ESCAP Executive Secretary also sent a note verbale to Member States reiterating the request, welcoming the active participation of Member States in the project.

16. As of the drafting of the present report, several Member States have responded to the request, with some showing interest in providing support for the project. Discussions with those interested Member States and further solicitation of support from others are ongoing.

## B. Assessment of the existing conditions of the Commission buildings

17. ESCAP has comprehensively studied the various elements of the project, namely, seismic code compliance, removal of hazardous materials, accessibility, replacement of life-cycle components, efficiency in space utilization, and energy efficiency.

### Seismic code compliance

18. To assess the seismic risk, an earthquake engineering consultant performed an initial visual inspection of the ESCAP premises in Bangkok in June 2012. The inspection clearly indicated vulnerable points in the secretariat and service building structures not in compliance with current Thai seismic codes and international best practices.

19. In 2013, ESCAP engaged a specialized structural engineering consultancy firm to assess the resistance of the secretariat and service buildings to potential strong seismic loads, in particular the seismic performance of the buildings related to life safety and collapse prevention, as well as the existing structural conditions of the buildings. The final seismic evaluation report, issued on 17 April 2014, revealed a need to undertake seismic mitigation measures, particularly for the secretariat building, and to a lesser extent the service building, in order for the buildings to be compliant with the current design standards for seismic resistance that are considered necessary for the safety of their users. Regarding the secretariat building, the results confirmed that (a) the reinforced concrete walls are not designed to withstand seismic loads; (b) the building fails to meet the prevailing national standards and international best practices for life safety and collapse-prevention performance; and (c) numerous structural failures would most likely occur between the secretariat building core and the office tower blocks in the case of a strong seismic event.

20. In 2016, ESCAP engaged an international consultancy firm working with the Asian Institute of Technology to reassess the seismic risk, conduct a comparison with the previous assessments, design the seismic retrofit of ESCAP premises and perform an assessment of life-cycle replacement requirements.

21. The seismic analysis of the secretariat and service buildings conducted during the period January-July 2016 confirmed all of the findings from the 2014 study in terms of structural behaviour in the event of earthquake activity, and the failure to meet applicable seismic codes and standards. Those are the most recent Thai code issued by the Department of Public Works and Town & Country Planning, Thailand (DPT 1302-52 for "seismic loading" and DPT 1303-57 for "seismic evaluation and retrofit of existing buildings") and the American Society of Civil Engineers

standards (ASCE 7-10 and ASCE 41-13), from which the Thai codes are directly derived.

22. The results of the study show that in the secretariat building approximately 20 per cent of the existing columns and beams require retrofit. The walls at both ends and the core walls, not having been designed to withstand horizontal loads, show inadequate capacity to resist seismic loads owing to insufficient wall thickness, and therefore they require retrofit. The service building, as it is a low-rise construction, is less vulnerable to seismic forces and only 5 per cent of its structural elements require retrofit. The retrofit requirements of the service building are relatively minor, affecting only a few columns and beams along the perimeter of the building. Construction works may be performed without moving staff from the building into swing space.

**Removal of hazardous materials**

23. To assess the current environmental status and determine whether hazardous materials are present, the Commission engaged an international environmental engineering firm to perform a survey of building components. The assessment, performed in the period January-April 2016, focused on the presence of asbestos-containing materials, heavy metals and any other potentially dangerous compounds and materials.

24. The results of the assessment, based on 50 sampling positions taken in February 2016, indicate a minimal presence of asbestos-containing materials confined in the mechanical workshops in the lower basements with restricted access. It is therefore not considered a major health risk at present. However, the methodology for the retrofit would address that issue and would take into account issues of staff safety, environmental pollution and noise challenges prior to and during the construction phase.

**Accessibility**

25. As required by the General Assembly in its resolution 70/170, on the full realization of an inclusive and accessible United Nations for persons with disabilities, a comprehensive review will be conducted during the project planning (phase 2), in 2017. Specific elements to be included in the review will address physical, sight, hearing and cognitive disabilities, with the goal of all-access design, signage, access aids, doors, furniture and office layouts, controls (namely, lighting area control) and fire egress.

**Replacement of life-cycle components**

*Marble cladding*

26. In 2010 ESCAP appointed a consultant to assess the status of the exterior marble cladding of the secretariat building. Results from assessments conducted in the period 2010-2012 showed that the marble cladding panels at the "end walls" are in reasonable condition, with about 20 per cent of the panels or the restraint system to be replaced, whereas those in the "link walls" are in very poor condition, with about 80 per cent dislodged, loose and cracked. Temporary repairs to some areas were carried out in the past. Emergency works are currently under way on 30 per cent of the marble panels for safety reasons to prevent heavy elements from falling

off the wall. The locations of "end" and "link" walls are indicated in annex I to the present report.

*Glazing*

27. The glazing systems of neither the secretariat nor the service building have been replaced since the initial construction of the building. The glazing system comprises a 6-mm single glass layer and aluminium frames. A study performed by a consultant in 2012 found that the current glazing system is very energy inefficient and a retrofit with a double-laminated and insulated glass with coating on the surface system would provide an estimated improvement in energy performance of 16 to 18 per cent as compared to existing conditions.

*Other life-cycle components, including information technology infrastructure*

28. In February 2016, ESCAP contracted a local specialized cost estimating/quantity surveying consultant to corroborate the findings of the previous assessment performed in 2014, which was to identify and quantify all capital costs associated with the seismic retrofit and life-cycle replacement components. The 2014 assessment included the development of all-inclusive cost estimates and associated schedules for each proposed life-cycle replacement, as indicated in the report of the Secretary-General on the strategic capital review (A/68/733), including the provision of a comprehensive assessment of the current conditions of the Commission's electro-mechanical systems.

29. The detailed assessment was conducted by the local consultant in coordination with the Information Management, Communications and Technology Section and the Facilities Management Unit of the local Central Support Services Section of ESCAP, and the Office of Central Support Services and the Office of Information and Communications Technology at Headquarters. Each contributed their expertise on the necessity, the design and the cost of the proposed works.

30. The findings indicate that life-cycle elements such as the exterior closure (marble cladding, façade and glazing), the roofing, the interior (furniture, finishes, staircases); and the services (conveying, plumbing, air conditioning and electrical systems) of both the secretariat and the service buildings will be at or beyond their maximum useful lives by the year 2025. The information, communications and technology infrastructure, the building management system, the public address system and the sprinkler fire suppression systems have all been recently upgraded and do not require replacement. To the extent that renovation works may affect these newer installations, the project team will ensure that abortive works are avoided. However, the information, communications and technology infrastructure would be affected by all scope options, and would therefore need to be removed and replaced.

**Efficiency in space utilization**

31. The total gross area of office space of ESCAP premises, including all three buildings (secretariat, service and conference centre), totals 25,886 $m^2$, with 1,873 work stations, as detailed in Table 1.

32. Tenants housed on the ESCAP premises are the International Labour Organization (ILO), the Joint United Nations Programme on HIV/AIDS, the United

Nations Entity for Gender Equality and the Empowerment of Women, the United Nations Office for Project Services, the United Nations Convention to Combat Desertification, the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), the United Nations Office for Disaster Risk Reduction, the United Nations Human Settlements Programme, the Office for the Coordination of Humanitarian Affairs, the United Nations Population Fund, the Office of the United Nations High Commissioner for Human Rights, the United Nations Office on Drugs and Crime, the Office of the United Nations High Commissioner for Refugees, the United Nations Regional Centre for Peace and Disarmament in Asia and the Pacific, the United Nations Capital Development Fund and the Department of Management, as well as commercial tenants.

Table 1
**Breakdown of total space, including number of workstations per building, Commission staff and tenants**

| | *Gross area office space (square metres)* | | | *Workstation (numbers)* | | |
|---|---|---|---|---|---|---|
| *Building* | *ESCAP* | *Tenants* | *Total* | *ESCAP* | *Tenants* | *Total* |
| Secretariat building | 9 497 | 7 882 | 17 379 | 620 | 668 | 1 288 |
| Service building | 1 411 | 4 415 | 5 826 | 74 | 382 | 456 |
| Conference Centre | 1 828 | 853 | 2 681 | 71 | 58 | 129 |
| **Total** | **12 736** | **13 150** | **25 886** | **765** | **1 108** | **1 873** |

33. ESCAP space usage is not as efficient as that of the funds and programmes. For example, UNDP recently renovated an area of 2,128 $m^2$ on the third floor of the service building, housing 164 workstations. Staff members average a space efficiency of 13 $m^2$ per workstation in this area. UNDP has also been using swing space on the first floor of the service building, occupying 827 $m^2$ to accommodate 87 workstations.

34. In 2015, ESCAP contracted a local architecture firm to produce office space designs, based on the space guidelines used for the capital master plan in New York, for all office space in the complex, including the secretariat, conference and service buildings. The designs are intended for general consideration and planning purposes.

35. The consultant was asked to review the current layout of the space and propose a concept that takes into consideration all spatial requirements and working methodologies, as well as the organizational structure and efficiencies of location.

36. The study, concluded in the first quarter of 2016, highlighted that by applying the capital master plan guidelines, ESCAP can gain as much as 20 per cent in space efficiency as compared to existing conditions, if a renovation of the interior office space were to be implemented.

37. In addition, because the office space would be converted from enclosed to open offices, the new configuration would be well suited to adopt flexible workplace strategies. ESCAP has not conducted a change management exercise for flexible workplace strategies, so the potential gain has not yet been quantified; however, additional efficiency could be achieved, building on the project already

under way at Headquarters in New York and in planning in Geneva, should flexible workplace strategies be eventually adopted at ESCAP.

**Energy efficiency**

38. In 2012, an international consultant was engaged to undertake a study of the façade systems at the ESCAP premises in Bangkok with respect to its current energy performance and potential improvements. The façade performance or energy consumption associated with cooling comprises three main components, namely, chiller, pumping and fan loads. An improvement in façade performance would impact chiller loads directly and pump/fan loads indirectly. The vision glazing is the greatest contribution to the cooling load and consequently there is significant scope to improve both solar heat gain and insulation performances. Improving the insulation of solid walls would also have significant benefits.

39. The analysis suggests that improvement in energy efficiency may be achieved with combined energy savings by improving the insulation and glazing at the secretariat building only, in the range of 16 and 18 per cent as compared to existing conditions.

## C. Local knowledge, in-house capacity and lessons learned from other capital projects

40. On 14 April 2016, representatives of ESCAP management and the Assistant Secretary-General, Office of Central Support Services, Department of Management, met with senior representatives of the United Nations Educational, Scientific and Cultural Organization (UNESCO). The purpose of the visit was to study the results of the recent renovations and seismic retrofit to the UNESCO building and to benefit from their experience. The Ministry of Education of the Government of Thailand, which owns the UNESCO building, supervised and oversaw the design and its implementation. This successful retrofit project has mitigated the seismic risk, making the UNESCO building code compliant, and it was delivered within required quality, planned timeline and budget. In order to glean lessons learned and best practices from similar interventions in Thailand, ESCAP also met with a representative of the Ministry of Education in order to exchange ideas and receive valuable suggestions for the project.

41. The lessons learned from the other capital projects executed by the Secretariat, as summarized in the report of the Secretary-General on the strategic capital review (A/69/760), have been duly taken into consideration in all project phases, from the pre-planning phase to the closeout phase. The project would follow the procedures and practices set forth in the Guidelines for the Management of Construction Projects issued by the Office of Central Support Services in January 2016.

42. In accordance with General Assembly resolution 70/248, section XII, paragraph 10, and the recommendation contained in the report of the Board of Auditors on the capital master plan regarding the enhancement of in-house capability in infrastructure project management and asset management strategy, ESCAP has made organizational changes within the Facilities Management Unit of the Central Support Services Section in order to manage the real estate and the property more efficiently and to be compliant with the International Public Sector Accounting Standards reporting requirements. As a result, the assets management

sub-unit has been segregated from the routine operations of maintaining the premises and is now being led by a professional staff at the National Officer level. The team in the sub-unit has worked with the Facilities and Commercial Services Division of Office of Central Support Services to gain from best practices in Secretariat offices and to strengthen its ability to handle capital projects. There is continuous interaction with the Office of Central Support Services to upgrade the skills of the ESCAP team.

43. More recently, ESCAP has been included in the UNEP pilot project undertaken jointly with the Swedish Environment Protection Agency for the establishment of an Environment Management System at ESCAP. In May 2016, the UNEP-Swedish Environment Protection Agency team conducted a capacity-building workshop at ESCAP to upgrade the skills of key staff. The pilot project would be dove-tailed with the proposed seismic project to harness maximum benefit with respect to environmental performance.

### D. Swing space requirements and availability (onsite and offsite)

44. The project requires swing space to temporarily accommodate staff while office space is impacted by the retrofit works. Each of the four options presented in section III utilizes a different implementation methodology, requiring a different number of floors in the secretariat building to be vacated and, as a result, the amount of swing space required will vary. ESCAP has identified 1,200 $m^2$ of temporary swing space on site on the ESCAP premises, distributed within three buildings (see annex I). The remaining space needs would be met by a combination of either host country contributions and/or commercially leased space. Table 2 shows swing space needs and availability.

45. In the first quarter of 2016, ESCAP contracted a local real estate consultant to conduct property surveys and market research and analysis and to provide competitive market data, leasehold rental rates and fit-out costs. The consultant also provided information regarding the availability of office space in a number of locations that could be used as swing space either for the required remaining balance or in the event the host country is not able to provide space.

Table 2
**Swing space needs in various options ($m^2$)**

| *Option* | *A* | *B* | *C* | *D* |
|---|---|---|---|---|
| Required | 15 456 | 4 800 | 4 800 | 2 520 |
| Onsite ESCAP | 1 200 | 1 200 | 1 200 | 1 200 |
| Offsite | 14 256 | 3 600 | 3 600 | 1 320 |

## III. Project overview

### A. Project purpose

46. The purpose of the project is to ensure the health and safety of staff, delegates and visitors at the Commission premises in Bangkok.

47. In General Assembly resolution 70/248, section XII, paragraph 5, the Assembly requested the Secretary-General to present an updated proposal and costing estimates for multiphase and single-phase implementation methods, including an option to address the seismic risk on its own and an option in combination with renovation, life-cycle replacement or other works, ensuring the most cost-effective and efficient method of implementation.

48. During the reporting period, ESCAP studied a range of preliminary options by varying the scope of the project and the implementation strategy in order to address, in the most cost-effective way, issues related to building performance, energy conservation, space-usage efficiency and the life-cycle replacement of building systems that have reached the end of their useful lives.

## B. Objectives

49. The key project objectives, established at the inception of the project plan, are in line with the key objectives outlined in the report of the Secretary-General on the strategic capital review (A/68/733). The project objectives are:

(a) To maintain the property value of United Nations premises, especially related to building life-cycle replacement;

(b) To meet industry norms related to health and safety issues, including fire and life safety planning and systems design, fire suppression, fire alarm and fire exit planning;

(c) To meet industry norms relative to facilities preparedness and design against potential natural disasters and emergency situations, such as earthquakes, tsunamis and hurricanes/typhoons;

(d) To ensure compliance with all relevant regulations related to persons with disabilities, including provisions concerning accessibility and technology;

(e) To ensure that hazardous materials are removed from facilities;

(f) To improve space usage efficiency by maximizing the use of available office and meeting space and minimizing sizes of building support spaces; this is to be achieved via optimization of the use of the available interior spaces and meeting facilities, providing flexible and functional spaces;

(g) To modernize outdated major building systems, including mechanical, electrical, low-voltage electrical, plumbing and conveying and vertical transportation, in order to meet industry norms;

(h) To move towards more energy efficient facilities, specifically by reducing energy consumption, fresh water consumption, use of non-renewable material resources and waste generation, and improving atmospheric and indoor air quality;

(i) To keep disruption of the work of the United Nations to a minimum and to ensure business and operational continuity throughout any project implementation.

## C. Options comparison

50. Four main options have been developed (as summarized in table 3).

51. Assuming pre-construction planning, design and tender will be done in 2017 and 2018 regardless of the option taken, the main differences among the four options are:

Option A: Seismic and associated costs only, all at once, four years:

(a) The scope is limited to the structural works necessary to address the seismic risk with the associated works to reinstall elements impacted by the retrofit works such as glazing, façade and office space installations that are to be removed to allow access to and clearance around beams and columns to be retrofitted. The office space installations have to be reinstalled after completion of retrofitting of the structure. However, under this option no space redesign will be undertaken, thus there will be no benefit of space efficiency;

(b) The methodology for construction envisages one cycle of works of the duration of two years (2019-2020) requiring emptying of the whole ESCAP secretariat building;

(c) The estimated total duration of the project is four years (2017-2020), of which two years would be for the design and tendering and two years for construction.

Option B: Seismic and associated costs only, five years:

(a) The scope is the same as in option A but with a phased implementation; no space redesign will be undertaken, thus there will be no benefit of space efficiency;

(b) The methodology for construction envisages four cycles of work with a duration of nine months each, with total construction lasting three years (2019-2021). Each cycle requires emptying four floors of the secretariat building at a time;

(c) The estimated total duration of the project is five years (2017-2021), two of which would be used for the design and for tendering and three for construction.

Option C: Combined seismic and associated costs and life-cycle components, quick phased, six years:

(a) The scope includes the structural works necessary to address the seismic risk plus the urgent life-cycle work components determined following the recommendations contained in the report of the Secretary-General on the strategic capital review (A/69/760) and on the basis of the initial review and findings presented in the preceding report (A/68/733). The option would also include a complete redesign of office layouts to achieve space efficiencies;

(b) The methodology for construction envisages four cycles of work with a duration of 12 months each, with total construction lasting four years (2019-2022). Each cycle requires emptying four floors of the secretariat building at a time;

(c) The estimated total duration of the project is six years (2017-2022), two of which would be used for the design and for tendering and four for construction.

Option D: Combined seismic and associated costs and life-cycle components, long phased, eight years:

(a) The scope is the same as in option C but extended over a longer period of time to reduce the number of floors that need to be emptied at one time and therefore minimizing swing space needs. This option also includes a complete redesign of office layouts to achieve space efficiencies;

(b) The methodology for construction envisages eight cycles of work with a duration of nine months each, with total construction lasting six years (2019-2024). Each cycle requires emptying two floors of the secretariat building at a time;

(c) The estimated total duration of the project is eight years (2017-2024), two of which would be used for the design and for tendering and six for construction.

52. An additional option, E, has also been considered but not fully developed. In that scenario, for planning purposes it was assumed that the life-cycle components only would be replaced in 2025, after the completion of the seismic project. At that time, the remaining useful life of all the life-cycle components would have expired. The purpose of option E is to evaluate for comparison purposes whether there is any gain in economy of scale in executing both the seismic and life cycle aspects of the project together (option C or D) versus performing them individually (options A+E or B+E). Option E is utilized in table 3 to equalize the benefits across all options A, B, C and D to be able to compare the cost-effectiveness of each option once the life-cycle benefits are taken into consideration.

**Table 3**
**Project options**

| *Design options* | *Single phase* | *Timeline phased* | *Phased* |
|---|---|---|---|
| Seismic and associated costs | **A**<br>M: All floors at one time<br>T: 4 years (2D+2C) | **B**<br>M: Phased 4 floors<br>T: 5 years (2D+3C) | |
| Seismic + life cycle | | **C**<br>M: Phased 4 floors<br>T: 6 years (2D+4C) | **D**<br>M: Phased 2 floors<br>T: 8 years (2D+6C) |
| Life cycle only | **E**<br>Implementation of the full life-cycle component as standalone after and independently, from the seismic component — earned value comparison analysis<br>T: 6 years (2D+4C) | | |

*Abbreviations*: M, Methodology; number of floors at one time to be emptied to retrofit the building; T, Timeline; D, Design duration; C, Construction duration.

# IV. Options analysis and schedules

## A. Project plan and schedules

53. Based on the information initially provided in the report of the Secretary-General (A/70/356), the overall project plan has been restructured into six phases, in alignment with the Guidelines for the Management of Construction Projects for use in implementing large-scale construction projects. The project phases are:

(a) Phase 1 — Pre-planning:

(i) Visual inspection study by a seismic engineer, completed in 2012;

(ii) Feasibility study and assessment of the buildings' structure and condition by a local specialized structural engineering adviser, completed in 2014;

(iii) Preliminary structural design of the seismic retrofit works by a local specialized structural seismic engineering company, completed in June 2016;

(iv) Preparation of the business case and establishment of the project governance structure, completed in July 2016;

(b) Phase 2 — Planning: establishment of the project management team; development of initial project programme, including recruitment of the lead architect, risk management firm and third-party structural review consultant; development of architectural requirements (and life-cycle component, in case option C or D is adopted); development of the final project governance;

(c) Phase 3 — Design: detailed structural seismic retrofit design and architectural design (and life-cycle component, in case option C or D is adopted), specifications and scope of works;

(d) Phase 4 — Tender: preparation of detailed design information, bills of quantities and technical specifications, leading to the development of the bidding documents;

(e) Phase 5 — Construction: implementation of seismic retrofit (and life-cycle renovation works, in case option C or D is adopted), project administration, testing and commissioning, substantial completion and handover;

(f) Phase 6 — Close-out: defects liability period; final completion of punch list items, project close-out and documentation on lessons learned.

54. The proposed project schedules for the four options are summarized in the Gantt chart in figure 1. A cost summary for comparative analysis is provided in table 4.

Figure 1
**Project schedules in various options**

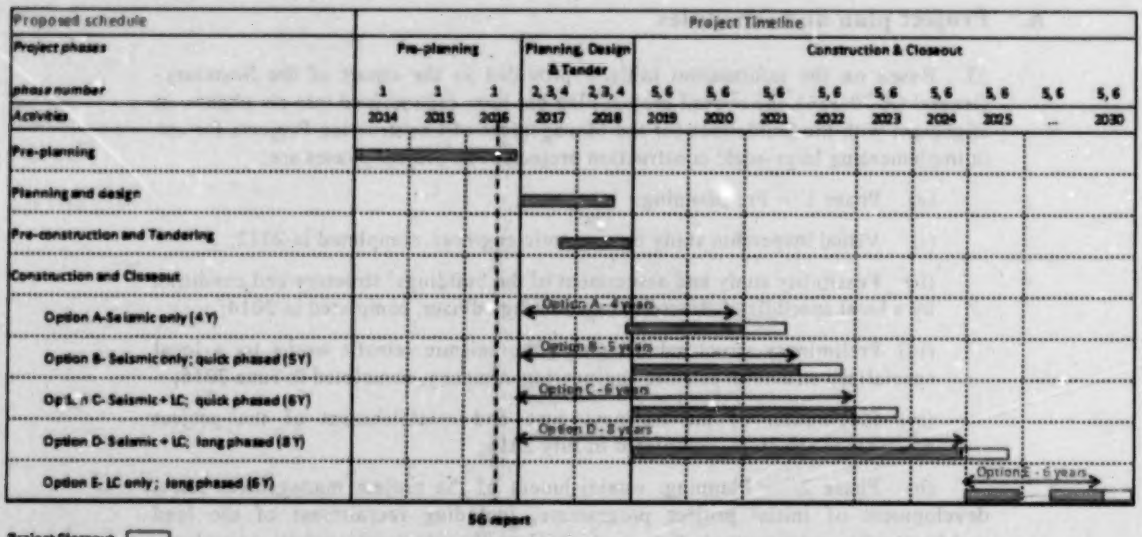

Proposed schedule
Project Timeline
Project phases
Pre-planning
Planning, Design & Tender
Construction & Closeout
phase number
1 1 1 2,3,4 2,3,4 5,6 5,6 5,6 5,6 5,6 5,6 5,6 5,6 5,6
Activities
2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 ... 2030
Pre-planning
Planning and design
Pre-construction and Tendering
Construction and Closeout
Option A-Seismic only (4 Y)
Option A - 4 years
Option B- Seismic only; quick phased (5Y)
Option B - 5 years
Option C- Seismic + LC; quick phased (6Y)
Option C - 6 years
Option D- Seismic + LC; long phased (8 Y)
Option D - 8 years
Option E- LC only; long phased (6 Y)
Options E - 6 years
5G report
Project Closeout

Table 4
**Summary of estimated costed options**
Estimated cost (millions of United States dollars)

| | | *A* | *B* | *C* | *D* |
|---|---|---|---|---|---|
| Project duration in years, including planning, design and construction phases 2-5 | Option scope | Seismic only | Seismic only | Seismic and life-cycle | Seismic and life-cycle |
| | Duration | 4 years | 5 years | 6 years | 8 years |
| | Methodology | All at once | Quick phased | Quick phased | Long phased |
| **1 Trade costs** | | | | | |
| 1.1 Seismic mitigation | | 8.49 | 8.66 | 4.67 | 4.97 |
| 1.1.1 Structural deficiencies | | 4.32 | 4.49 | 4.67 | 4.97 |
| 1.1.2 Associated costs (reinstallation of impacted infrastructure)[a] | | 4.17 | 4.17 | – | – |
| 1.2 Life-cycle replacement (for options C and D only) | | – | – | 13.62 | 14.50 |
| 1.3 Swing space costs[b] | | 17.99 | 5.43 | 6.53 | 4.08 |
| **Subtotal: trade costs** | | | **26.48** | **14.10** | **24.82** |
| 2 Consultancy fees | | 1.56 | 1.61 | 2.37 | 2.37 |
| 3 Escalation | | 3.53 | 2.24 | 4.76 | 5.64 |
| 4 Contingencies | | 3.16 | 1.79 | 3.20 | 3.16 |
| 5 Project management cost | | 3.05 | 3.96 | 4.88 | 6.13 |
| **Subtotal (1): (1 to 5)** | | 37.77 | 23.70 | 40.02 | 40.84 |

| | | A | B | C | D |
|---|---|---|---|---|---|
| 6 | **Life-cycle replacement costs when the project is executed separately** *(applicable only for options A and B as line item 1.2 above covers these costs for options C and D)* | | | | |
| | 6.1 Life-cycle replacement undertaken separately[c] | 16.48 | 16.48 | – | – |
| | 6.2 Swing space costs[d] | 4.61 | 4.61 | – | – |
| 7 | Consultancies fees[d] | 1.11 | 1.11 | – | – |
| 8 | Escalation[d] | 3.52 | 3.52 | – | – |
| 9 | Contingencies[d] | 2.57 | 2.57 | – | – |
| 10 | Project management cost[d] | 1.73 | 1.73 | – | – |
| | **Subtotal (2): (6 to 10)** | **30.02** | **30.02** | – | – |
| | **Total = subtotal (1) + subtotal (2)** | **67.79** | **53.72** | **40.02** | **40.84** |

[a] Associated costs are reinstallation costs of the impacted elements of the secretariat building owing to the seismic retrofit project. Marble cladding, glazing and the office furnishings have to be removed to access the shear walls, columns and beams for strengthening.

[b] The swing space costs include both onsite and offsite space. The offsite cost includes the rental of office space in the real estate market with rates projected by external real estate consultant; the office furniture and all required services (information technology and security installation and services, shuttle bus to and from ESCAP, etc.). The onsite costs include the site preparation and design, the construction costs, the furniture and information technology services.

[c] Life-cycle replacement undertaken in accordance with the schedule covered in the report on the strategic capital review (A/68/733) commencing from 2025 for the duration of six years.

[d] These project costs will be incurred again if the life-cycle component is undertaken independently after the completion of seismic retrofitting as covered under the methodology of options A and B.

## B. Escalation and contingency

55. Allowance for escalation has been added to the construction costs and consultancy estimates, at a rate of 4 per cent per annum, based on a forward projection of published data on recent past escalation rates, and based on the advice of a specialist cost consultant. The baseline for the estimate is July 2016, and the estimated escalation is compounded and applied to the annual expenditure projections.

56. Given the early stage of the design, and in line with the provisions set forth in the United Nations Guidelines for the Management of Construction Projects, the contingency provision was developed on the basis of a traditional percentage method, taking into consideration past experience with similar projects and other variables that may have an impact on the accuracy of the project cost estimates, especially during the early stages of project planning, including the project size, the complexity and the location. Because the project entails the renovation of an existing occupied building, it is very likely that unforeseen conditions would be encountered and changes to the implementation plan required. For planning purposes, a contingency provision of 10 per cent of the estimated construction cost of the project, inclusive of consultancy fees, has been included. A more detailed analysis of the required contingency provision would be provided once the General Assembly selects an option, and as the project is further developed, including a quantitative risk analysis and a projection of required contingency on a cost-to-complete basis.

## C. Cost-benefits and risk management

57. The purpose of the cost-benefit analysis and the risk assessment is to determine the overall best value project option and to identify and propose mitigation strategies for the risks associated with each option.

58. Among the primary objectives of the project are to reduce the disruption to existing operations and to reduce project costs through realistic and optimized design and construction schemes.

59. In order to maintain essential operations, ESCAP would need to use the current United Nations Conference Centre, which provides a full range of conference services as required for both calendar and non-calendar meetings of the ESCAP secretariat, the United Nations agencies, funds and programmes and meetings organized by external clients (non-United Nations entities), on a cost-reimbursement basis. With almost 3,000 meetings taking place annually at the United Nations Conference Centre, it is critical that there is minimal impact on conducting those meetings, in particular those that require interpretation and translation services that cannot be provided by any other facility in Bangkok.

60. The purpose of the risk management analysis is to identify potential problems before they occur, so that risk-mitigation activities may be planned and invoked as needed across the life of each proposed option, to mitigate adverse impacts on achieving the project's and ESCAP objectives and benefits. The risk matrix, contained in table 5, summarizes the various risks for each option, and the likelihood and impact of each. Major risks have been identified in business continuity, such as the ability to access the United Nations Conference Centre and the availability of swing space during project implementation.

Table 5
**Risk matrix**

| *Risk* (1) | *Option* (2) | *Description* (3) | *I*[a] (4) | *L*[b] (5) | *Score* (6=4x5) | *Risk category*[c] (7) | *Mitigation* (8) |
|---|---|---|---|---|---|---|---|
| 1 Business continuity[d] | A | 1,288 staff, 4 locations | 5 | 5 | 25 | Strategic | Movement of staff and logistic challenges are factored into the project cost |
| | B | 300 staff, 2 locations | 5 | 3 | 15 | | |
| | C | 300 staff, 2 locations | 5 | 3 | 15 | | |
| | D | 110 staff, 1 location | 5 | 2 | 10 | | |
| 2 Availability of swing space[e] | A | 15,456 | 5 | 5 | 25 | Operation | Sought support from host country to provide swing space, and engaged a local firm to investigate the real estate market providing costs and availability of commercially rented office space |
| | B | 4,800 | 5 | 3 | 15 | | |
| | C | 4,800 | 5 | 3 | 15 | | |
| | D | 2,520 | 5 | 2 | 10 | | |
| 3 Procurement of infrastructure works[f] | All | Limited market | 5 | 3 | 15 | Operation | Enlargement and enrichment of United Nations Global Marketplace vendor database, outreach to international and national interested vendors |

| *Risk* (1) | | *Option* (2) | *Description* (3) | *I*[a] (4) | *L*[b] (5) | *Score* (6=4x5) | *Risk category*[c] (7) | *Mitigation* (8) |
|---|---|---|---|---|---|---|---|---|
| 4 | Project duration (critical activities)[g] | A | 4 years | 4 | 1 | 4 | Operation | 80 per cent of the seismic retrofit activity occurs at the beginning of the project in each option; however, shorter project duration implies full seismic retrofit reached earlier and minimal disruptions to operations |
| | | B | 5 years | 4 | 2 | 8 | | |
| | | C | 6 years | 4 | 2 | 8 | | |
| | | D | 8 years | 4 | 4 | 16 | | |
| 5 | Design and construction[h] | A | 4 years | 4 | 1 | 4 | Operation | Design and construction risks have been taken care of in the design scope |
| | | B | 5 years | 4 | 2 | 8 | | |
| | | C | 6 years | 4 | 2 | 8 | | |
| | | D | 8 years | 4 | 4 | 16 | | |
| 6 | Procurement procedure[i] | All | | 4 | 5 | 20 | Operation | A procurement officer included in the project team to support the technical and commercial evaluation |
| 7 | Tenants not returning to ESCAP premises | A | 638 tenants[j] | 5 | 4 | 20 | Operation | Tenants are prioritized to occupy onsite swing space |
| | | B | 223 tenants[j] | 5 | 2 | 10 | | |
| | | C | 167 tenants[j] | 5 | 1 | 5 | | |
| | | D | 111 tenants[j] | 5 | 1 | 5 | | |
| **8** | **Overall risk score** | **A** | | | | **113** | | |
| | | **B** | | | | **91** | | |
| | | **C** | | | | **86** | | |
| | | **D** | | | | **92** | | |

*Notes*:

[a] Impact: 5 — critical; 4 — significant; 3 — high; 2 — moderate; 1 — low.

[b] Likelihood: 5 — expected; 4 — highly likely; 3 — likely; 2 — not likely; 1 — slight.

[c] Risk category — "Strategic" means those risks related to high-level goals, aligned with and supporting the Organization's charter vision and mandate; "Operation" means those risks related to effective and efficient use of the Organization's resources (that is, programme management, human resources, etc.).

[d] Business continuity: ability to perform project with no impact on ESCAP operations. The risk increases with the number of staff members in swing space and the number of different and scattered locations in Bangkok.

[e] Availability of swing space: the risk increases with the increasing number of square metres to be sought outside beyond the 1,200 $m^2$ of swing space available onsite at ESCAP.

[f] Procurement of infrastructure works: limited market competition for the ESCAP renovation works contract.

[g] Project duration: critical activities with life safety component such as seismic retrofit risks increase with duration of the project implementation.

[h] Design and construction: an increased project duration increases the risk associated with project assumptions, cost escalation, availability of material and logistic chain.

[i] United Nations procurement procedures and timelines will prolong the purchase of materials and resources as and when required.

[j] Average number of tenants on offsite swing space per year.

## D. Option analysis

### Option A

61. Implementing option A would put ESCAP at the highest risk, with a score of 25 for business continuity, because it would require the emptying of the whole secretariat building, with the relocation of about 1,288 staff to swing spaces. ESCAP staff would have to commute daily from offsite swing spaces to the ESCAP

Conference Centre to participate and organize conferences. That would be challenging owing to the high traffic congestion in Bangkok throughout the day and the lack of available swing space in the vicinity of ESCAP. Option A would also require 15,456 $m^2$ of swing space, of which only 1,200 $m^2$ would be available inside ESCAP in temporary locations. Real estate market research shows that the remaining 14,256 $m^2$ of swing space could not be provided in a single location, but rather in a minimum of four locations scattered throughout Bangkok. The risk of not finding available office space is also at its highest score of 25. The total risk score of option A is 113 on a scale of 175; option A has the highest risk score among the four options studied.

62. Option A addresses exclusively the health and safety code compliance objectives of the project, namely, to meet industry norms related to health and safety issues, including fire and life safety planning and systems design, fire suppression, fire alarm and fire exit planning; and to meet industry norms relative to facilities preparedness and design against potential natural disasters and emergency situations, such as earthquakes, tsunamis and typhoons as defined by the strategic capital review.

63. Option A would incur the highest cumulative loss (during the project period) related to rental income from tenants estimated at $890,000 (not included in table 4, which only reflects project costs).

64. Option A project cost (seismic mitigation alone) amounts to $37.77 million. In order to determine the cost-effectiveness of option A, compared to all other options, the benefits must be equalized across options A, B, C and D. Once the life-cycle benefits are taken into consideration, the total cost of option A would be $67.79 million. If the loss of rental income during the project period is further factored in, the cost of option A would amount to $68.68 million.

**Option B**

65. Option B delivers the same benefits as option A, addressing only health and safety and code compliance, with the only difference being that option B utilizes a phased implementation methodology, bringing the project duration to five years. Requiring only 4,800 $m^2$ of swing space and proportionally less staff members on temporary location, the risk is lower, scoring 15. The risk of not finding available office space is also lower, with a score of 15. The total risk score of B is 91 on a scale of 175.

66. Option B would incur the cumulative loss of rental income from tenants estimated at $330,000 (not included in table 4, which only reflects project costs). The option B project cost (seismic mitigation alone) adds up to $23.70 million. Once the life-cycle benefits are taken into consideration, the total cost of option B would be $53.73 million. If the loss of rental income during project period is further factored in, the cost of option B would amount to $54.06 million.

**Option C**

67. Option C addresses all the project objectives, including energy efficiency and modernization of mechanical, electrical and plumbing systems; improving space efficiency involving modernizing working practices to take a coherent and integrated approach to staff management, technology, workspace and processes; and

compliance with standards related to persons with disabilities. Specifically, option C would grant an enhancement of space efficiency of 20 per cent and improvement of energy performance in the range of 16 to 18 per cent with the installation of new glazing and façade systems. A gain of 20 per cent in space efficiency in the ESCAP staff-occupied area in the building would create 1,800 $m^2$ of additional space for rent equivalent to $540,000 per annum rental income after project completion. The total risk score of C is 86 on a scale of 175; option C has the lowest risk score of the four options studied.

68. For option C, the cumulative loss of rental income from tenants calculated is estimated at $440,000 (not included in table 4, which only reflects project costs); the security costs at $190,000; and the cost of swing space at $7.42 million. Option C has an identical swing space requirement as option B, therefore an identical risk score of 15 for both business continuity and finding available office. The option C project cost amounts to $40.02 million. If the loss of rental income during the project period is further factored in, the cost of option C would be $40.46 million.

**Option D**

69. Option D is identical to option C in terms of benefit and risks, but with different costs owing to a longer project implementation timeline of eight years. Similarly to option C, it would also achieve a gain of 20 per cent in space efficiency, which would create an additional 1,800 $m^2$ available for rent equivalent to annual rental revenue of $540,000 after project completion. For option D, the cumulative loss of rental income from tenants is estimated at $330,000 (not included in table 4, which only reflects project costs); the security costs at $95,000; and the cost of swing space at $4.90 million. The total risk score of option D is 92 on a scale of 175.

70. The option D project cost would be $40.84 million. If the loss of rental income during the project period is further factored in, the cost of option D would be $41.17 million.

71. A projection of loss of rental income per annum from tenants to Member States in various project options is provided in table 6, whereas table 7 consolidates all risks, benefit and costs of each option for a comparative analysis.

Table 6
**Loss of rental income from tenants in various project options**

| *Option* | *A* | *B* | *C* | *D* |
|---|---|---|---|---|
| Duration in swing space (years) | 3 | 3.5 | 4.5 | 6.5 |
| Cumulative loss over the project period (United States dollars) | 890 000 | 330 000 | 440 000 | 330 000 |

Table 7
**Risk, benefit, cost analysis matrix**

| | *Item* | *Strategic capital review category* | *A* | *B* | *C* | *D* |
|---|---|---|---|---|---|---|
| **A** | **Risks** | | | | | |
| 1 | Business continuity | j | 25 | 15 | 15 | 10 |
| 2 | Availability of swing space | | 25 | 15 | 15 | 10 |
| 3 | Procurement of infrastructure works | | 15 | 15 | 15 | 15 |
| 4 | Project duration (critical activities) | | 4 | 8 | 8 | 16 |
| 5 | Design and construction | | 4 | 8 | 8 | 16 |
| 6 | Procurement procedure | | 20 | 20 | 20 | 20 |
| 7 | Tenants leaving ESCAP premises | | 20 | 10 | 5 | 5 |
| | **Sum of risk scores (items 1 to 7)** | | **113** | **191** | **86** | **92** |
| **B** | **Benefits** | | | | | |
| | *Qualitative* | | | | | |
| 8 | Industry norms | b, c | | | | |
| | 8.1 Seismic (Department of Public Works and Town and Country Planning, Thailand, and American Society of Civil Engineers) | | Y | Y | Y | Y |
| | 8.2 Electro-Mechanical Building Systems | | N | N | Y | Y |
| 9 | Modern working environment[a] | | N | N | Y | Y |
| 10 | Energy efficiency (Sustainable Development Goals)[b] | h | N | N | Y | Y |
| 11 | Accessibility[c] | d | N | N | Y | Y |
| 12 | Property value[d] | a | Partial | Partial | Y | Y |
| 13 | Modernization of building system | g | 10% | 10% | 100% | 100% |
| 14 | Hazardous material | e | N | N | Y | Y |
| | *Quantitative (millions of United States dollars if not per cent)* | | | | | |
| 15 | Energy efficiency[e] (gain range per cent) | h | 0 | 0 | 16-18% | 16-18% |
| 16 | Space efficiency (additional rental income per annum) | f | 0 | 0 | 0.54 | 0.54 |
| **C** | **Costs** | | | | | |
| | *(millions of United States dollars)* | | | | | |
| 17 | Trade costs | | 26.48 | 14.10 | 24.82 | 23.55 |
| 18 | Consultancy fees | | 1.56 | 1.61 | 2.37 | 2.37 |
| 19 | Escalation | | 3.53 | 2.24 | 4.76 | 5.64 |
| 20 | Contingencies | | 3.16 | 1.79 | 3.19 | 3.16 |
| 21 | Project management costs | | 3.05 | 3.96 | 4.88 | 6.13 |
| | **Project costs (items 17 to 21)** | | **37.77** | **23.70** | **40.02** | **40.84** |
| 22 | Life cycle replacement costs (if implemented separately) | | 30.02 | 30.02 | – | – |

| | Item | Strategic capital review category | A | B | C | D |
|---|---|---|---|---|---|---|
| | **Project costs (with equalized benefits) (items 17 to 22)** | | **67.79** | **53.72** | **40.02** | **40.84** |
| D | **Loss of rental income during project period** | | 0.89 | 0.33 | 0.44 | 0.33 |
| | **Total costs (with equalized benefits, and takes into account loss of rental income)** | | **68.68** | **54.05** | **40.46** | **41.17** |

*Abbreviation*: Y, meets the requirement; N, does not meet the requirement.

*Note*: Strategic capital review (A/68/733) categories: (a) Property value; (b) Health and safety; (c) Preparedness disaster; (d) Human right disabilities; (e) Hazardous material; (f) Space use efficiency; (g) Modernization of building; (h) Energy efficiency; (i) Heritage asset; (j) To keep disruption of the work of the United Nations to a minimum, and to otherwise ensure business and operational continuity throughout any project implementation.

*Notes*

[a] Space efficiency, higher space efficiency involving modernizing working practices to take a coherent and integrated approach to staff management, technology, workspace and processes (such as the capital master plan space guideline and flexible workplace).

[b] Sustainable Development Goal 7: ensure access to reliable, sustainable and modern energy for all. By 2030, double the global rate of improvement in energy efficiency.

[c] Addressing resolution 67/160, in which the Assembly requests the Secretary-General to continue the progressive implementation of standards and guidelines for the accessibility of facilities and services of the United Nations system, taking into account relevant provisions of the Convention on the Rights of Persons with Disabilities, in particular when undertaking renovations, including interim arrangements (para. 10).

[d] In relation to the maintenance investment to maintain the property value as defined in table 3 of the report on the strategic capital review (A/68/733).

[e] Energy efficiency enhancement is indicated in this table in percentage of kilowatts. However, that does not mean the corresponding saving in expenditures. It needs to be calculated at any given time based on actual utility unit rates.

### E. Recommendation

72. The Secretary-General considers option C ($40.019 million) to be the most cost-effective solution. Option C has the lowest risk score of 86. Option C would provide benefits for ESCAP operations with a 16 to 18 per cent enhancement of energy efficiency, improvement in space efficiency of 20 per cent and a $540,000 projected annual increase (after project completion) in rental income. Option C would not only deliver benefits in all of the key strategic objectives, but it would also provide an opportunity to address in the most cost-effective manner issues related to building performance, energy conservation, space usage efficiencies and the life-cycle replacement of building systems that will have reached the end of their useful lives. Those objectives would guide the development of the project scope, with the goal of providing staff, delegates and visitors with modern, safe, healthy and functional office facilities that address the current and future requirements of the United Nations.

## V. Project governance

### A. Project owner and oversight

73. The project owner would be the Executive Secretary of ESCAP. The Executive Secretary has designated the Director, Division of Administration as Project

Executive, who would be responsible for managing the dedicated project management team, interacting with internal and external stakeholders, along with strategic issues requiring senior-level decision-making. The day-to-day project execution would be under the leadership of the dedicated Project Manager. The proposed project governance and management structures are set out in Annex II to the present report; these are based on the generic structure contained in the Guidelines for the Management of Construction Projects issued by the Office of Central Support Services in January 2016, which was modified for this specific project. The salient features of the governance structure are:

(1) Well-defined coordination and support on the various aspects of the project between the Office of Central Support Services at Headquarters and ESCAP to facilitate the sharing of knowledge and provide alerts and early remedial action in case issues arise;

(2) Early establishment of the dedicated project management team and support functions with clear reporting lines;

(3) The establishment of a stakeholders committee to assist the Executive Secretary at ESCAP and the Director of Administration to proactively manage the project;

(4) The inclusion of an independent risk management framework early on in the project development process.

74. The stakeholders committee would be led by the Executive Secretary, or her designee, and would provide her with advice and guidance with respect to the operational aspects of the project. The committee would not be able to make changes that would affect the project scope, schedule or cost. The committee would draw its members from ESCAP, other secretariat offices based within the Commission's premises in Bangkok and external entities.

75. ESCAP members of the stakeholders committee would include the Central Support Services Section, Conference Management Unit, the Strategy and Programme Management Division, the Strategic Communication and Advocacy Section and the Security and Safety Section. Membership from other secretariat offices includes the Office of Information and Communications Technology, the Department of Security and Safety and the Office of Central Support Services at United Nations Headquarters in New York. Advice and input from other stakeholders such as the United Nations country team offices located on the Commission premises (UNEP, UNDP and ILO) would also be sought, as and if required. In addition, external stakeholders, such as the Ministry of Foreign Affairs of the Royal Thai Government would be updated periodically on the project. The stakeholders committee would be informed on the details of the project at key milestones with regard to its scope, schedule and cost.

76. The Secretary-General is also mindful of the recommendation of the Advisory Committee on Administrative and Budgetary Questions, paragraph 21 of its report (A/70/7 (Add.3)), that the establishment of an Advisory Board for the project should be considered. While still under consideration, the Secretary-General wishes to draw a distinction between the present proposed project, the programme requirements of which are relatively straightforward (as it entails the renovation of only office space), as compared to larger projects for which Advisory Boards have been established that entail more complex scopes comprised of multiple use spaces

(conference rooms, technical rooms, commercial areas and office space). As such, the Secretary-General is currently disinclined towards the establishment of an Advisory Board for this project, but stands ready to receive additional guidance from the General Assembly on the matter.

## B. Role of the Office of Central Support Services

77. The Office of Central Support Services, as indicated in ST/SGB/2013/1, provides support and coordination to offices away from Headquarters and regional commissions in the management of their properties and construction projects. In line with General Assembly resolution 70/248, section XII, paragraph 11, the role of the Office on the project has been established and is included in the overall governance structure (see annex II).

78. The Office provides overall project oversight, provides ESCAP with technical guidance and advice on the project, ensures that the project will comply with overall organizational objectives, for example, those set out in the strategic capital review, share lessons learned from other capital projects undertaken by the Organization and coordinate with New York-based project stakeholders, across Secretariat Departments and Governing Bodies.

79. In addition, and in consideration of the guidance received from the General Assembly in its resolution 70/248, section IX, paragraph 13, on the renovation of the Africa Hall at the Economic Commission for Africa, and the recommendation of the Advisory Committee on Administrative and Budgetary Questions in its report on the seismic mitigation project at ESCAP (A/70/7/Add.3, paras. 22 and 27), the Office of Central Support Services would take a lead role in providing independent risk management services for both projects. To that effect, the Office is in the process of procuring the services of a specialist risk-management firm to assist in providing the Organization with expert services, including a quantitative risk assessment. Such services would be managed centrally by the Office in New York, and funded on a per-project basis as a part of the project cost plans.

## C. Dedicated project team

80. As indicated in the lessons learned from the other capital projects of the secretariat (A/69/760), having a dedicated project management team of an adequate size, starting early in the planning stage of the project and working continuously through to project completion are essential components to ensure the success of a capital project of such size. The proposed dedicated project team would be composed of a Project Manager, project team staff, project support staff, independent and integrated risk management service providers and external specialized consultants. The dedicated project team working on site would have the same member composition in number and functions, but for a different duration, in accordance with project implementation timeline. The project team working in an offsite swing space would have the same functional requirements (that is, coordination, security and information), but with a different number of personnel, depending on the number and duration of swing space locations, which would depend on the implementation option.

*ESCAP project team*

81. The team would be led by the Project Manager (P-5). It should be noted that the level of the Project Manager is now proposed to be at the P-5 level instead of the P-4 level, as compared to the previous proposal of the Secretary-General (see A/70/356), in order to accurately reflect the required levels of expertise and responsibility of the Project Manager, as well as the appropriate reporting lines within the corporate governance structure. Under the leadership of the Project Manager, the project team would be composed of one Project Engineer (P-4), who would also assume responsibility for integrated risk management, one Civil and Structural Engineer (P-3), for the initial part of the project when design and major structural work take place and one Project Administrative Assistant (Local level), all starting from 1 January 2017. In addition, the project team would be complemented by one Building Mechanical-Electrical-Plumbing Engineer (National Officer), one Logistics and Coordination Officer (National Officer) for construction supervision and one Safety Project Officer (Local level) for the whole phase V, starting from 1 January 2019. Table 8 shows the time frames of the proposed positions of the project team, using option C as an illustration. For the other options, the starting date of each position would not change, but the ending dates would vary to align with the different project time frames under options A, B and D.

Table 8
**Duration of project staff**

| *Positions* | *Phases 2, 3 and 4* | | *Phases 5 and 6 (using option C as an illustration)* | | | | |
|---|---|---|---|---|---|---|---|
| | *2017* | *2018* | *2019* | *2020* | *2021* | *2022* | *2023* |
| Project Manager (P-5) | | | | | | | |
| Project Engineer (P-4) | | | | | | | |
| Civil and Structural Engineer (P-3) | | | | | | | |
| Building Mechanical-Electrical-Plumbing Engineer (NO) | | | | | | | |
| Logistics and Coordination Officer (NO) | | | | | | | |
| Safety Project Officer (LL) | | | | | | | |
| Project Administrative Assistant (LL) | | | | | | | |
| Procurement Officer (P-3) | | | | | | | |
| 2 Security Officers (LL) for 2 swing space locations | | | | | | | |
| 2 IT Assistants (LL) for 2 swing space locations | | | | | | | |
| Project Coordinator based at Headquarters, 50 per cent cost-shared (P-4) | | | | | | | |

*Project support*

82. The project support team would be composed of one Procurement Officer (P-3) from the project onset (January 2017) until the contract signature, scheduled for 2019. For each of the swing space locations and for the duration of occupancy, the support team would also require one Security Officer (Local level) and one Information Technology Assistant (Local level). For option A, it is anticipated that there would be four off-site swing space locations. Hence, option A would require four Security Officers and four Information Technology Assistants. Options B and C

entail two off-site swing space locations, and hence would require two Security Officers and two Information Technology Assistants. Option D entails only one off-site swing space location, and it therefore would require one Security Officer and one Information Technology Assistant. The project support envisages also 50 per cent of the cost of a Project Coordinator (P-4) for the entire duration of the project. That position would be based in the Office of Central Support Services at Headquarters and cost-shared between ESCAP and the Economic Commission for Africa. The other 50 per cent of that position would be funded from within the approved overall project cost of the Africa Hall project, as explained in the report of the Secretary-General on the progress in the construction of new office facilities at the Economic Commission for Africa, and update on the renovation of conference facilities, including Africa Hall (A/71/370).

83. Please refer to annex II for a chart depicting the project governance structure and to annex III for the functions of each of the proposed project management and project support positions.

*Consultancy services*

84. External to the United Nations, but within the dedicated project management team, the services of consultants, contractors and suppliers would be required. Given the specialized nature of the project, external consultancies for the provision of seismic engineering, architectural and engineering design and construction management services would be needed to produce detailed technical documentation. Such specialized design services would include not only seismic and structural retrofit engineering, but also architectural and engineering design services for the replacement of the exterior cladding and glazing, heating/ventilation/air-conditioning systems, electrical systems and office space and interior fit-out designs. In addition, specialized architectural consultancy services would be required for evaluating the implementation of flexible workplace arrangements. These specialized services would be managed and coordinated by the lead architectural and engineering firm. Whereas the role of the dedicated project management team would be to coordinate and oversee the works on behalf of the United Nations, the external consultants would be responsible for producing the actual detailed design and construction documents prior to the procurement of renovation services.

## D. Independent risk management

85. In order to implement a robust integrated approach to risk management in line with industry best practices, an independent risk-management firm is proposed to be included as part of this project similar to those services incorporated into the governance of other substantial capital projects undertaken by the United Nations. The risk management framework would include the development and use of a risk register, and a risk-based approach to the establishment and management of the contingency provision.

86. To that end, the independent risk-management firm would report directly to the Office of Central Support Services in New York to provide an independent assessment on the course of the various project actions, provide expertise to the project, assist in identifying and mitigating any risks that may impact the successful delivery of the project and support informed decision-making.

87. The dedicated project management team, including its consultants, would be responsible for integrated risk management as part of the regular/ongoing project management process.

# VI. Next steps

88. Upon approval by the General Assembly of the project, the following activities would be undertaken in 2017:

(a) Finalization of the approved governance structure;

(b) Establishment of the stakeholders committee;

(c) Establishment of the dedicated project management and project support team;

(d) Establishment of the risk management plan;

(e) Hiring of the consulting lead architect;

(f) Performing the concept design for the selected project scope and implementation strategy;

(g) Performing a comprehensive review of project requirements to ensure accessibility for persons with disabilities;

(h) Continuing to engage with the host country for the provision of swing space and technical assistance;

(i) Continuing to engage with Member States on possible voluntary contributions or in-kind support.

# VII. Project cost and resource requirements for the biennium 2016-2017

## A. Projected expenditures in 2016

89. The General Assembly, by its resolution 70/248, authorized the Secretary-General to enter into commitments in an amount not to exceed $400,000 under section 33, Construction, alteration, improvement and major maintenance, of the programme budget for the biennium 2016-2017 to cover the expenses to update the project proposal and costing estimates for multiphase and single-phase implementation methods, including an option to address the seismic risk on its own and an option in combination with renovation, life-cycle replacement or other works, ensuring the most cost-effective and efficient method of implementation. At the time of writing of the present report the expenditures as at 31 December 2016 is projected to be $396,200, as detailed in table 9.

Table 9
**Projected expenditures under the commitment authority in 2016**
(In United States dollars)

| | |
|---|---|
| **Other staff costs** | |
| Actual as at 31 July 2016 | 171 300 |
| Projected at 31 December 2016 | 115 400 |
| **Subtotal — Other staff costs** | **286 700** |
| **Consultants** | |
| Cost estimate/quantity survey consultant | 44 000 |
| Real estate consultant | 6 500 |
| Architectural consultant | 59 000 |
| **Subtotal — Consultants** | **109 500** |
| **Total** | **396 200** |

90. In accordance with General Assembly resolution 70/248, section XII, paragraph 13, the utilization of the $400,000 commitment authority will be reported in the context of the first performance report of the programme budget for the biennium 2016-2017.

## B. Resource requirements in 2017

91. For 2017, during the first year of the planning phase (phase 2), all options would have the identical resource requirement as detailed in the cost plans in annex IV. That is because the planning, the design and the preconstruction activities, for the period 2017-2018, are not affected by the different construction timelines of options A, B, C or D. The 2017-2018 activities include the procurement of the lead architecture and engineering firm, the third-party seismic proof design, the risk management consultant, the construction management firm and the contractor. Activities include also the recruitment of the project management team.

Table 10
**Resource requirements in 2017 by cost component**
(In United States dollars)

| | |
|---|---|
| Project management | 505 600 |
| Consultancy fees | 325 000 |
| Escalation | 13 000 |
| Contingencies | 33 800 |
| **Total** | **877 400** |

Table 11
**Resource requirements in 2017 by budget section and object of expenditures**
(In United States dollars)

| *Budget section* | *Object of expenditures* | *Amount* |
|---|---|---|
| Section 19, Economic and social development in Asia and the Pacific | Other staff cost | 505 600 |
| Section 33, Construction, alteration, improvement and major maintenance | Consultants | 371 800 |
| **Total** | | **877 400** |

**Section 19, Economic and social development in Asia and the Pacific**

*Other staff cost ($505,600)*

92. Resources in the amount of $505,600 would provide for the dedicated project management team and support functions in 2017, comprising one Project Manager (P-5), one Project Engineer (P-4), one Civil and Structural Engineer (P-3), one Procurement Officer (P-3), one Project Administrative Assistant (Local level); and 50 per cent of the cost of one Project Coordinator (P-4) based at Headquarters cost-shared with the Africa Hall project at the Economic Commission for Africa.

**Section 33, Construction, alteration, improvement and major maintenance**

*Consultants ($371,800)*

93. Resources in the amount of $371,800 would provide for consultancy services in 2017 for the detailed seismic design, the third-party proof design and an architectural consultant to develop a proposed solution for flexible workplace strategies. That amount comprises a base cost of $325,000, escalation of $13,000 and contingencies of $33,800.

## C. Resource requirements in 2018 and beyond

94. For 2018 (planning, design and tendering stages; phases 2, 3 and 4 of the project), a lead architectural and engineering design firm and an independent risk-management firm would be required. The resource requirements in 2018 would vary depending on which option is adopted, owing to the varying swing space costs (rentals, furnishings, construction and services) to be incurred before the construction phase, which is planned for 2019 in all options. Option A would have the highest cost in 2018 owing to the significant requirements of swing space, whereas options B, C and D would have less but similar resource requirements.

95. From 2019 onward (construction stages; phase V of project), a construction management firm would be required. The lead architectural and engineering design firm would (a) develop the implementation master plan; (b) generate independent schematic and detailed design documentation for the swing spaces and overall project scope so that a comprehensive construction bid exercise could be undertaken; (c) coordinate all the design activities, including seismic mitigation measures and building systems; and (d) oversee the phased construction. The independent risk-management firm would (a) perform risk management and quality

assurance tasks during design and construction and produce an overall risk strategy; (b) propose a risk monitoring process inclusive of a risk register; and (c) suggest mitigation measures against potential risks. The construction management firm would monitor the construction execution performing quality control and assurance.

## VIII. Recommended actions to be taken by the General Assembly

96. **The General Assembly is recommended to:**

**(a) Approve option C for the seismic mitigation retrofit and life-cycle replacements project, its proposed scope, the implementation plan and estimated cost of $40,019,000, at 2016-2017 initial rates, for the period from 2017 to 2023;**

**(b) Approve the establishment of the dedicated project management team and project support staff;**

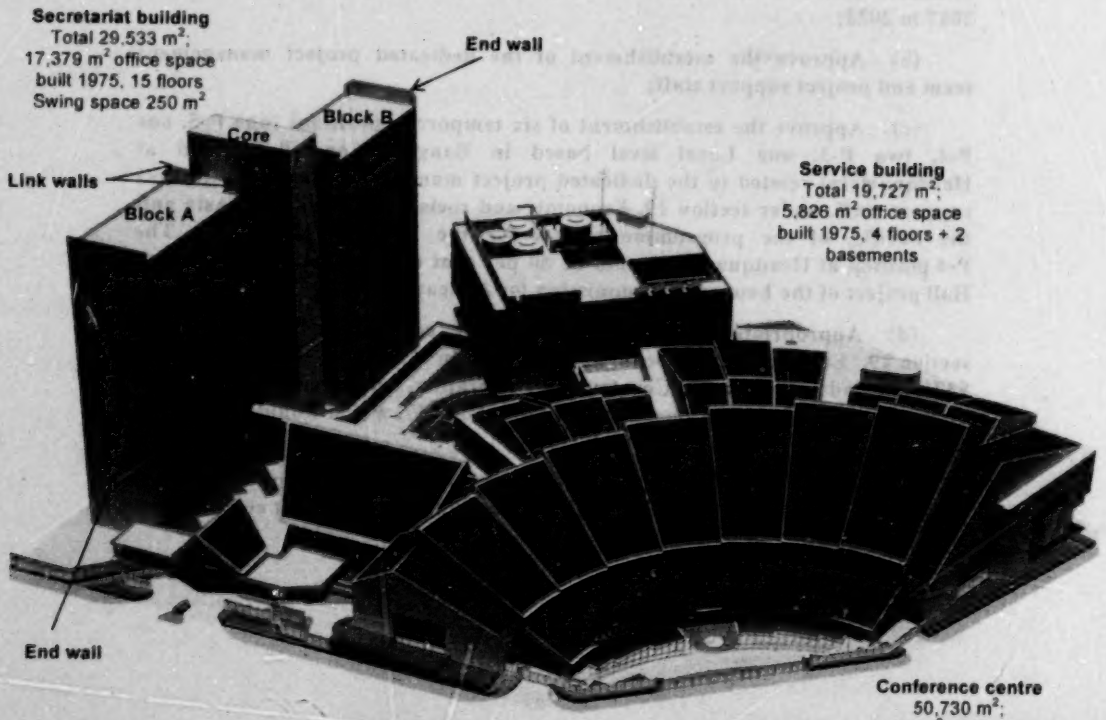
**(c) Approve the establishment of six temporary positions (one P-5, one P-4, two P-3, one Local level based in Bangkok; one P-4 based at Headquarters) related to the dedicated project management team and project support staff, under section 19, Economic and social development in Asia and the Pacific, of the programme budget for the biennium 2016-2017. The P-4 position at Headquarters would be 50 per cent cost-shared with the Africa Hall project of the Economic Commission for Africa;**

**(d) Appropriate an amount of $877,400, comprising $505,600 under section 19, Economic and social development in Asia and the Pacific, and $371,800 under section 33, Construction, alteration, improvement and major maintenance, of the programme budget for 2016-2017, which would represent a charge against the contingency fund;**

**(e) Approve the establishment of a multi-year construction-in-progress account for the expenditures of the project from 2017 until project completion.**

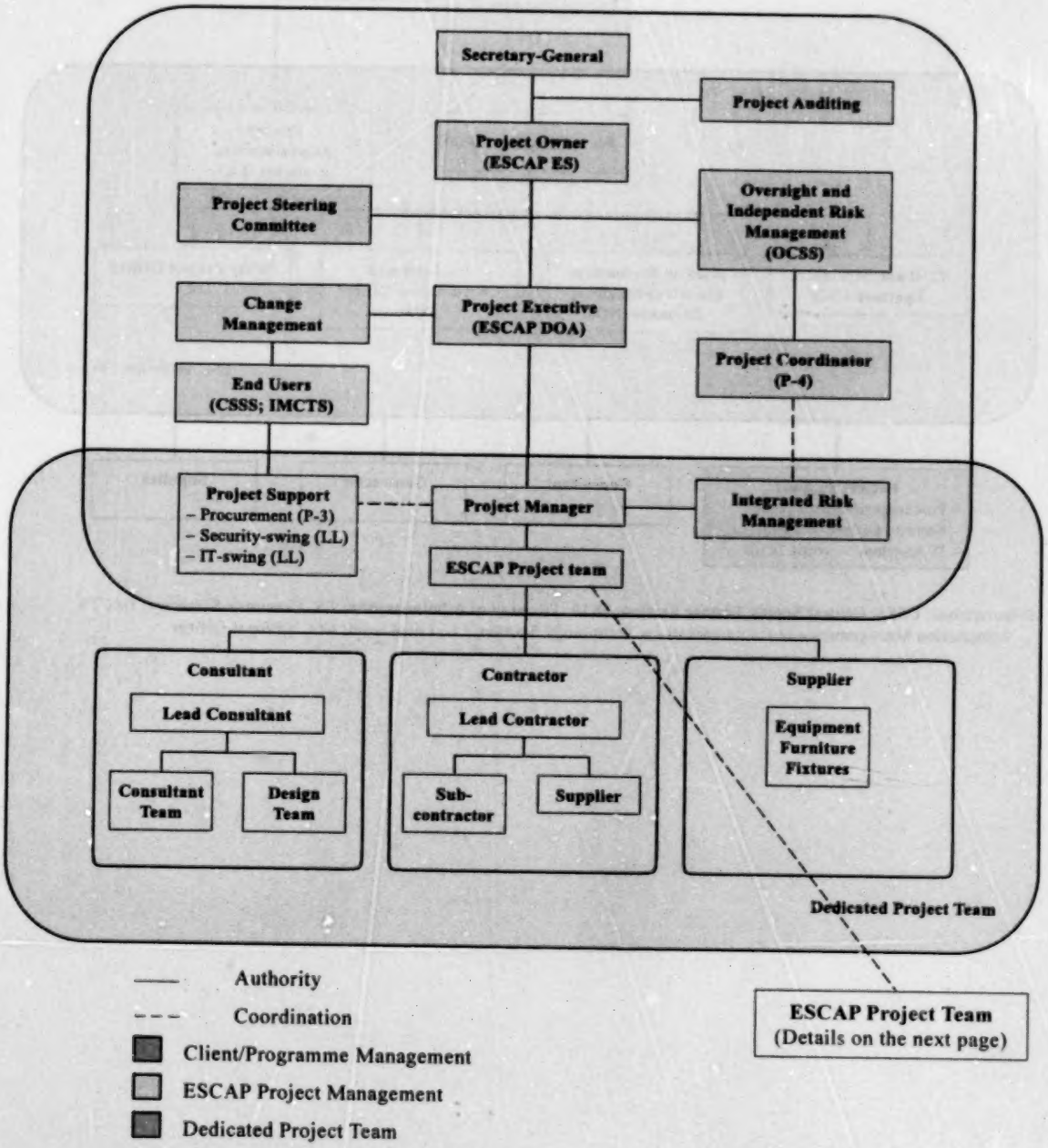
## Annex I

### ESCAP premises in Bangkok

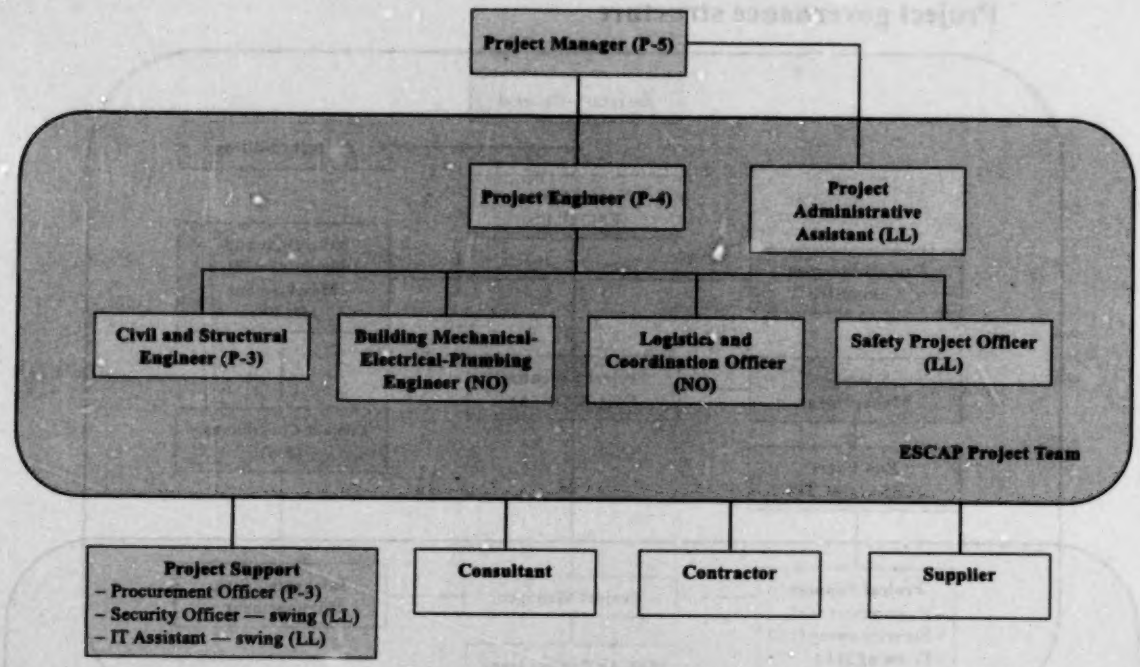


# Annex II

## Project governance structure



## ESCAP Project Team composition




*Abbreviations*: CSSS, Central Supply Service Section; DOA, Division of Administration; ES, Executive Secretary; IMCTS, Information Management and Communications Technology Section; LL, Local level; NO, National Officer.

# Annex III

## Roles of the project management team and project support staff

*Dedicated project management team*

(a) **Project Manager (P-5)**: This position would have the overall responsibility for the successful initiation, planning, design, execution, monitoring, control and closure of the project. The Project Manager would oversee the whole project and be the key person responsible for managing the day-to-day aspects of the project in accordance with applicable standards. The responsibilities of the Project Manager would include planning and defining scopes; activity planning and sequencing; resource planning; developing schedules; managing risks and issues; cost control; risk analysis; documentation; monitoring and reporting on progress; team leadership; ensuring liaison between affected parties; and quality assurance and control. The Project Manager would have overall technical and administrative responsibility and accountability, through the Division of Administration, to the Executive Secretary and any advisory committees;

(b) **Project Engineer (P-4)**: The incumbent of the position would report to the Project Manager and be responsible for analyses, review and advice on the project planning, site investigation, design, logistics, construction, maintenance, site utility integration and commissioning of systems and facilities for the project. He or she would coordinate the evaluation, the review and the revision of the project documents, and would analyse design specifications included in project proposals for accuracy, soundness, feasibility and cost. He/she would prepare project reports, recommend solutions to unusual project problems and provide expert technical advice on overall policies, procedures and guidelines pertinent to the project;

(c) **Civil and Structural Engineer (P-3)**: The incumbent of the position would report to the Project Engineer and, owing to the high level of civil engineering works in the project in terms of seismic strengthening, this officer would be responsible for all issues with regard to civil engineering and seismic mitigation measures for the overall project, including reviewing construction methods, materials and quality standards, and drafting and interpreting specifications, drawings, plans and procedures. The officer would also monitor changes to designs, assess the effects on cost and measure and value variations to designs;

(d) **Building Mechanical-Electrical-Plumbing Engineer (National Officer)**: Reporting to Project Engineer, this position would be responsible for all technical issues with regard to the mechanical, the electrical and the plumbing, and the public health engineering aspects of the overall project, including communication lines, telephones and information and communications technology networks; energy supply, including electricity and renewable sources; escalators and lifts; fire detection and protection; heating, ventilation and air conditioning; lightning protection; low-voltage systems, distribution boards and switchgear; natural lighting and artificial lighting; security and alarm systems; and water, drainage and plumbing. He or she would be responsible for monitoring, analysing and responding to the construction contractors' reports once on board and would assist in monitoring and evaluating change-order proposals pertaining to mechanical and electrical components of the project;

(e) **Logistics and Coordination Officer (National Officer)**: This position would be responsible for the planning, the oversight and the management of the off-site and temporary on-site swing space accommodation (rented and constructed) and the movement of United Nations staff, tenants and service providers to such facilities in line with the project schedule. The officer would be tasked with ensuring a continuation of support to the substantive work programme of the Commission to ensure that disruptions caused by the overall project have a minimal effect on the organization's outputs;

(f) **Project Administrative Assistant (Local level)**: The position would report directly to the Project Manager and would be primarily responsible for preparing analysis and business reports as they apply to administrative budgetary finance requirements in compliance with Financial Regulations and Rules of the United Nations, International Public Sector Accounting Standards and Umoja requirements. Additionally, the incumbent would perform a range of essential tasks in the project office, including documentation control; drafting correspondence and reports; distributing meeting agendas and recording meetings; responding to enquiries from project stakeholders; assisting the project team in other administrative tasks as needed; and undertaking other duties such as account reporting, account monitoring control and general administrative functions;

(g) **Safety Project Officer (Local level)**: The position would be needed to control activities at the construction site for the duration of the construction beginning in 2019. The incumbents of the positions would report to the Project Engineer;

*Dedicated project support*

(h) **Procurement Officer (P-3)**: The position would report to the Chief of the Procurement Unit of ESCAP. Several large-scale international procurement actions are required to take place to address all the components of the project. The incumbent would be responsible for the oversight, the preparation and the finalization of all these tenders and contractual documents, contracts administration, background research and vetting process of the general contractor and numerous subcontractors, and communication with legal teams both at ESCAP and Headquarters. It is proposed that the Procurement Officer be recruited in 2016, in parallel with the additional dedicated project team members, and be essential in forwarding all the procurement actions required for the success of the renovation, including contract management, through construction;

(i) **Security Officers (Local level)**: One Security Officer would be needed to coordinate security at each swing place location beginning in 2019. The incumbents of the positions would report to the Chief of the Safety and Security Section or his or her designate;

(j) **Information Technology Assistants (Local level)**: One Information Technology Assistant would be needed to coordinate information technology services at each swing place location beginning in 2019. The incumbent would manage information and communications technology services at the off-site swing space, as the Information Management and Communications Technology Section at the Commission does not have the sufficient resources to cover this additional requirement;

(k) **Project Coordinator based at Headquarters, cost-shared (P-4)**: The incumbent of this position would provide day-to-day oversight, guidance and technical support to the ESCAP project manager, under the guidance of the Chief, Overseas Properties Management Unit. Emphasis would be placed on contract management of the independent risk-management firm, which would report directly to the Overseas Properties Management Unit in order to ensure its independent and external role, complementing the work of the dedicated project management team and facilitating the team's risk identification activities and development of mitigation strategy.

# Annex IV

## Detailed cost plans for each option[a]

(Millions of United States dollars)

| Option A | Phase | 2-4 | 2-4 | 5 | 5 | 6 | Total |
|---|---|---|---|---|---|---|---|
| | Year | 2017 | 2018 | 2019 | 2020 | 2021 | |
| 1. Trade costs | | – | 8.070 | 9.203 | 9.203 | – | 26.476 |
| 2. Consultancies fees | | 0.325 | 0.580 | 0.329 | 0.329 | – | 1.563 |
| 3. Escalation | | 0.013 | 0.706 | 1.190 | 1.619 | – | 3.528 |
| 4. Contingencies | | 0.034 | 0.936 | 1.072 | 1.115 | – | 3.157 |
| 5. Project management | | 0.506 | 0.696 | 0.696 | 0.916 | 0.232 | 3.046 |
| **Total** | | **0.877** | **10.987** | **12.491** | **13.183** | **0.232** | **37.770** |

| Option B | Phase | 2-4 | 2-4 | 5 | 5 | 5 | 6 | Total |
|---|---|---|---|---|---|---|---|---|
| | Year | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | |
| 1. Trade costs | | – | 2.139 | 5.863 | 3.264 | 2.831 | – | 14.096 |
| 2. Consultancies fees | | 0.325 | 0.611 | 0.369 | 0.168 | 0.134 | – | 1.607 |
| 3. Escalation | | 0.013 | 0.224 | 0.778 | 0.583 | 0.642 | – | 2.241 |
| 4. Contingencies | | 0.034 | 0.297 | 0.701 | 0.401 | 0.361 | – | 1.794 |
| 5. Project management | | 0.506 | 0.696 | 0.696 | 0.916 | 0.916 | 0.232 | 3.962 |
| **Total** | | **0.877** | **3.968** | **8.407** | **5.332** | **4.884** | **0.232** | **23.701** |

| Option C | Phase | 2-4 | 2-4 | 5 | 5 | 5 | 5 | 6 | Total |
|---|---|---|---|---|---|---|---|---|---|
| | Year | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | |
| 1. Trade costs | | – | 2.139 | 6.155 | 4.988 | 8.607 | 2.926 | – | 24.816 |
| 2. Consultancies fees | | 0.325 | 0.628 | 0.392 | 0.301 | 0.582 | 0.142 | – | 2.370 |
| 3. Escalation | | 0.013 | 0.226 | 0.817 | 0.899 | 1.991 | 0.814 | – | 4.760 |
| 4. Contingencies | | 0.034 | 0.299 | 0.736 | 0.619 | 1.118 | 0.388 | – | 3.195 |
| 5. Project management | | 0.506 | 0.696 | 0.696 | 0.916 | 0.916 | 0.916 | 0.232 | 4.879 |
| **Total** | | **0.877** | **3.988** | **8.796** | **7.724** | **13.215** | **5.187** | **0.232** | **40.019** |

| Option D | Phase | 2-4 | 2-4 | 5 | 5 | 5 | 5 | 5 | 5 | 6 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | |
| 1. Trade costs | | – | 1.431 | 3.879 | 3.134 | 4.336 | 6.739 | 2.141 | 1.892 | – | 23.553 |
| 2. Consultancies fees | | 0.325 | 0.531 | 0.266 | 0.209 | 0.302 | 0.488 | 0.132 | 0.112 | – | 2.365 |
| 3. Escalation | | 0.013 | 0.160 | 0.518 | 0.568 | 1.005 | 1.918 | 0.718 | 0.739 | – | 5.638 |
| 4. Contingencies | | 0.034 | 0.212 | 0.466 | 0.391 | 0.564 | 0.915 | 0.299 | 0.274 | – | 3.156 |
| 5. Project management | | 0.506 | 0.696 | 0.696 | 0.801 | 0.801 | 0.801 | 0.801 | 0.801 | 0.232 | 6.133 |
| **Total** | | **0.877** | **3.031** | **5.826** | **5.102** | **7.007** | **10.860** | **4.090** | **3.818** | **0.232** | **40.844** |

[a] The costs for life-cycle replacement after the implementation of options A and B are not included in this table.